Electronic Version
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Claims

[c1] Novel FTTP test apparatus for locating a fault of a transmission line in a communication system Optical Test Node (OTN) which transmits and receives a signal via a feeder at an optical frequency specified by a novel FTTP Test Algorithm. Said novel FTTP Test Algorithm being fundamental to the present invention. The communication system to be tested comprising of a OLT device connected to a feeder transmission line, a branching/coupling device which branches the feeder transmission line into a plurality of leg transmission lines each connected with the respective ONT devices. Wherein the OLT and the plurality of ONT devices perform bidirectional communication, said apparatus comprising:
an OTN containing an OTDR specially tuned to an optical frequency chosen using the novel FTTP Test Algorithm to be transmitting and receiving test signals at the optical frequency rejection area for the optical frequency splitting filter contained in the transceiver component contained in the ONT triplexer. The preferred embodiment of the present invention's novel FTTP Test Algorithm selects a frequency that is half way between the splitting filters high-pass and low-pass channels.

FTTP Test Algorithm choice of optical frequency enables transmission of certain optical pulse train test signals that stimulate the second transmission lines in such a way as to maximize the energy transferred to said second transmission lines to create a resonant condition on a unique second transmission line.

FTTP Test Algorithm means the application of composite (combined) optical pulse train test signals that result in a deterministic pattern of second transmission line stimulation in such a way as to result in a combined reflected signature in which only the desired second transmission line or group of second transmission lines are returning reflected energy to the head end optical measurement equipment.

FTTP Test Algorithm means for outputting a test signal at a specific optical frequency to the feeder using an OTDR, an optical selector switch and a band pass WDM module to stimulate the feeder (first transmission line) and detect a reflected energy of the test signal, for determining a distance to a fault point based on the time since the test signal is output until the reflected signal is detected and for comparing, for each of the legs (second transmission lines). The attenuation or reflective characteristics of both the end point components and that caused line impairments can be detected using standard industry apparatus specially tuned to said novel choice

of interrogation frequency and pulse repetition rate, the signal strength and the current attenuation of the reflected signal and application of unique and novel correlation comparison of baseline test results recorded at a time during plant certification and current test results and analysis of the optical signature of the transmission line system. The hardware and software of the OTN system can determine the presence or absence and location of a fault in the feeder (transmission line 1) or the leg (transmission line 2) without interruption to traffic in the communication bands. The invention method is not limited to a specific optical frequency but can be applied at any frequency within the pass band of the optical fiber.

[c2] The novel FTTP Test Algorithm and apparatus according to claim 1,
wherein the first transmission line and the plurality of second transmission lines are optical transmission lines, and
wherein the first transceiver device and, the plurality of second transceiver devices, the branching/coupling device, said attenuation means and said FTTP Test Algorithm means transmit and receive optical signals through the optical transmission lines connected to said devices.

[c3] The novel FTTP Test Algorithm apparatus according to claim 1,

wherein said FTTP Test Algorithm means the specific attenuation condition by an optical signal at a specific wavelength which is transmitted and reflected through the optical transmission lines.

[c4] The novel FTTP Test Algorithm apparatus according to claim 1,
wherein said FTTP Test Algorithm specifies the attenuation condition by using a test wavelength and selected optical pulse frequency or series of wavelengths and optical pulse frequencies chosen to be precisely within the on-optically transmissive section of the band pass filter with respect to the bidirectional service transmission frequencies.

[c5] The novel FTTP Test Algorithm apparatus according to claim 3,
wherein said FTTP Test Algorithm means outputs an optical test signal of a wavelength differing from a wavelength of the optical signals used in the communication between the first device and the plurality of second devices.

[c6] The novel FTTP Test Algorithm apparatus claim 1,
wherein said attenuation or reflectance indicates the presence or absence of impairments to the optical line, for each of the second transmission lines, an operation

to cause reflectance from a discontinuity in the index of refraction on the optical line for all of the second transmission lines when stimulated with said optical test signals for a predetermined period of time.

[c7] The novel FTTP Test Algorithm apparatus according to claim 2,
wherein said FTTP Test Algorithm means further specifies individual attenuation to be caused to the plurality of second transmission lines as the attenuation condition.

[c8] A method for locating a fault of a transmission line in a communication system in which a first device is connected to a branching/coupling device and thence separately to a plurality of second devices, said method comprising the steps of:
causing detection of individual attenuation to a plurality of transmission lines respectively connecting the branching/coupling device to the second devices outputting a test signal in a transmission line connecting the first device to the branching/coupling device; and locating a fault of the second transmission lines based on a delay time the test signal returns as a reflected signal and based on attenuation of the reflected signal.

[c9] A method for locating a fault of a transmission line in a communication system including a first device which

transmits and receives a signal via a first transmission line, a plurality of second devices and a branching/coupling device which branches the first transmission line into aplurality of second transmission lines each connected with the respective second devices, wherein the first device and the plurality of second devices perform bidirectional communication, said method comprising the steps of:

causing individual attenuation to a plurality of transmission lines respectively connecting the branching/coupling device to the second devices;

outputting a test signal in a transmission line connecting the first device to the branching/coupling device; and

locating a fault of the second transmission lines based on a delay time the test signal returns as a reflected signal and based on attenuation of the reflected signal.

[c10] A method for locating a fault of a transmission line in a communication system including a OLT first device which transmits and receives a signal via a first transmission line, a plurality of second devices and a branching/coupling device which branches the first transmission line into a plurality of second transmission lines each connected with the respective ONT second devices, wherein the first device and the plurality of second devices perform bidirectional communication, said test

method shall stimulate a transmission line condition comprising steps of:

(a) causing individual attenuation through destructive resonance or constructive resonance to the plurality of second transmission lines either individually or in combination using the principal of superposition of stimulus pulse shapes and repetition rates;

(b) outputting a test signal to the first transmission line and detecting a reflected signal of the test signal;

(c) determining a distance to a fault point based on the time since outputting the test signal in step (b) until detecting the reflected signal in step (b); and

(d) comparing, for each of the second transmission lines, the attenuation caused in step (a) with attenuation of the reflected signal detected in step (b) and based on the comparing, determining a faulty one of the second transmission lines.

(e) comparing historical or calculated results, for each of the second transmission lines, the attenuation caused in step (b) with attenuation of the reflected signal detected in step (c) and based on the comparing, determining a faulty second transmission line.